

REMARKS

Claims 10-18 were previously pending. Claims 11, 13, and 14 have been cancelled. Claims 10, 12, and 15-18 have been amended. The amendments are supported at least by the disclosures in paragraphs [0012], [0022], [0025], [0027], Examples 1-5, and Table 1. The amendments to claims 10 and 12 to add the limitation that said multifilament has an average strength of not lower than 38 cN/dTex are at least supported by paragraph [0024], Examples 1-5, and Table 1 because paragraph [0024] discloses that the average strength of the high strength polyethylene multifilament of the present invention is preferably not lower than 20 cN/dTex and each multifilament of Examples 1-5 had an average strength of not lower than 38 cN/dTex. New claim 19 has been added. Support for claim 19 can be found at least in paragraphs [0012], [0022], Examples 1-5, and Table 1. No new matter has been added. Upon entry of this Amendment, claims 10, 12, 15-19 will be pending.

Priority

The Office Action states that applicants' claim for priority for the subject matter of claims 11 and 12 based upon Japanese Application No. 2004-092305 filed March 26, 2004 is withdrawn and that Tam et al. (US 6,969,553) is a prior art against claims 11 and 12. Claim 11 has been cancelled. Claim 12, as amended, is supported by claims 1 and 5, Examples 1-5, and Table 1 of one of the priority applications of PCT/JP2004/018004, Japanese Patent Application No. 2004-201430, filed on July 8, 2004, which is prior to the earliest reference date of Tam, i.e., its filing date, September 3, 2004. See the attached Table 1 and English translation of the claims of Japanese Patent Application No. 2004-201430. Therefore, Tam is not prior art against present claim 12. Applicants note that claim 1 of JP Patent Application No. 2004-201430 was later amended to remove the phrase "according to claim 1."

Claim rejections – 35 U.S.C. §103

I. Applicants respectfully traverse the obviousness rejections of claims 11 and 12 over Tam under 35 U.S.C. §103(a). Claim 11 has been cancelled, rendering the rejection of claim 11 moot.

As discussed above, Tam is not a prior art reference against claim 12. Withdrawal of the obviousness rejection of claim 12 over Tam is requested.

II. Applicants respectfully traverse the obviousness rejections of claims 10-18 over PCT publication WO 01/73173 under 35 U.S.C. §103(a).

The claimed invention would not have been obvious over WO 01/73173 at least because WO 01/73173 does not teach or suggest a stress Raman shift factor of not smaller than $-5.0 \text{ cm}^{-1}/(\text{cN/dTex})$ or a knot strength retention of monofilaments constituting the high strength multifilament of not lower than 40%, as recited in claim 10, as amended. Also, WO 01/73173 does not teach or suggest a crystal size of monoclinic crystal of not larger than 9 nm, or a knot strength retention of monofilaments constituting the high strength multifilament of not lower than 40%, as recited in present claim 12, as recited. Because WO 01/73173 does not teach or suggest all limitations of claims 10 and 12, A prima facie case of obviousness has not been established.

WO 01/73173 discloses a high tenacity, high modulus multifilament yarn. A higher strength usually leads to a lower elongation and a higher modulus. A high strength polyethylene filament obtained by a gel spinning method usually has a high tensile strength because of its highly oriented structure, but may not have a sufficient knot strength and is easily broken by a relatively low stress when the filament is bent. When a filament has a non-uniform structure in its sectional structure, the filament is even more easily broken when it is bent. See paragraph [0009] of the specification. It was difficult to produce a high strength filament with a uniform structure and a desirable knot strength using the conventional gel spinning method.

The present invention provides a high strength polyethylene multifilament having a uniform internal structure with a low variation in the strengths of the monofilaments constituting the multifilament. Claims 10 and 12 have been amended to recite the additional features that the claimed high strength polyethylene multifilament has a stress Raman shift factor of not smaller than $-5.0 \text{ cm}^{-1}/(\text{cN/dTex})$ and a knot strength retention of monofilaments constituting the high strength multifilament of not lower than 40%. When the stress Raman shift factor is lower than $-5.0 \text{ cm}^{-1}/(\text{cN/dTex})$, a stress distribution due to concentration of stresses would likely occur. The concentration of stresses would become a starting point for destruction of a filament when the filament is distorted. See paragraph [0023] of the specification.

In addition, claims 10 and 12 have been amended to recite an average strength of not lower than 38 cN/dTex and a knot strength retention of monofilaments constituting the high

strength multifilament of not lower than 40%. The knot strength retention is defined as follows (see paragraph [0037] of the specification):

Knot strength retention = an average of the knot strengths of the
monofilaments/an average of the strengths of the monofilaments $\times 100$.

Applicants found that structural non-uniformity in the fine structure of a filament would lead to poor knot strength because stresses would concentrate on such sites of structural non-uniformity as a starting point when the filament is distorted (see paragraph [0008] of the specification). A filament low in structural non-uniformity tends to take a value within a region including a Raman shift factor so that the ratio of the knot strength to the tensile strength becomes higher (see paragraph [0009] of the specification). Also, in order to improve the knot strength, it is important to keep the sizes of monoclinic crystals to a low level. It is undesirable for the sizes of monoclinic crystals in a filament to exceed a certain limit in view of knot strength because upon distortion of the filament, stresses tend to concentrate at sites between the monoclinic crystals and the orthorhombic crystals, which would become starting points for destruction of the filament (see paragraph [0007] of the specification).

Based on these findings, the claimed high strength polyethylene multifilament are prepared by applying uniform cooling conditions to the filament-like solutions injected from the spinneret. The uniform cooling of the filament-like solutions may be achieved with a number of methods. For example, the filament-like solutions may be uniformly cooled in the spinning step by feeding an inert gas controlled within a range of ± 10 °C of the nozzle temperature individually to each of injected solutions at a velocity of higher than 1 m/second. See paragraphs [0014], [0016] and [0017] of the specification. The filament-like solutions may also be uniformly cooled in the spinning step with a cooling medium at a cooling speed of not lower than 1,000 °C/second and at an accumulated speed difference (defined by the following formula) of not larger than 30 m/minute. See paragraphs [0014], [0016], and [0018].

Accumulated speed difference = \int (the speed of the filament-like solution - the
speed of the cooling medium in the filament-pulling direction)

WO 01/73173 does not teach or suggest the uniform cooling conditions applied to the filament-like solutions injected from the spinneret as discussed above. Rather, WO 01/73173 discloses a method for producing a high tenacity, high modulus multifilament yarn in which the dimension of the spin gap between a spinneret and a quench bath is reduced to less than about 25 mm (page 7, lines 1-6). In view of the general knowledge that a high tenacity, high modulus multifilament yarn would suggest a low knot strength retention, it would not have been obvious to modify the multifilament of WO 01/73173 to achieve the high strength polyethylene multifilament with the knot strength retention as recited in present claims 10 and 12. Furthermore, WO 01/73173 does not teach or suggest the high strength polyethylene multifilament of the present invention with a uniform internal structure, consisting of a plurality of filaments having a narrow variation in their strengths.

Claim 16 further recites that said multifilament has an elongation at break of from 3.5% inclusive to 5.0% inclusive. It is a general knowledge that a higher strength usually leads to a lower elongation and a higher modulus. A high strength polyethylene multifilament obtained by gel spinning has a very high tensile strength but may be insufficient in knot strength. The high strength polyethylene multifilament of claim 16 has a higher elongation at break than the filaments known in the prior art. See Examples and Comparative Examples in Table 1.

For at least the foregoing reasons, claims 10-18 would not have been obvious over WO 01/73173. Withdrawal of the rejections is respectfully requested.

CONCLUSION

The Examiner is encouraged to contact the undersigned regarding any questions concerning this amendment. In the event that the filing of this paper is deemed not timely, applicants petition for an appropriate extension of time. The Commissioner is authorized to debit Deposit Account No. 11-0600 the petition fee and any other fees that may be required in relation to this paper.

Respectfully submitted,

KENYON & KENYON LLP

Dated: January 7, 2009

By: /Qi Zhao/
Qi Zhao
Reg. No. 64,129

1500 K Street, N.W., Suite 700
Washington, D.C. 20005-1257
(202) 220-4200 (telephone)
(202) 220-4201 (facsimile)

Enclosures

1. Table 1 of Japanese Patent Application No. 2004-201430
2. English translation of the claims of Japanese Patent Application No. 2004-201430